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GENERATOR OF REPETITIVE SETS OF SPREADING SEQUENCES

DESCRIPTION

5   ## Technical domain

The purpose of this invention is a generator of repetitive sets of spreading sequences.

The invention is broadly applied for digital communications and more particularly for Wireless Local
10   Area Networks (WLANs), Wireless subscriber Local Loops (WLL), mobile telephony, intelligent building management systems, remote charging, communication for transport, cable television, multimedia services on cable networks, etc.

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State of prior art

The spread spectrum technique is broadly known and has been described particularly in the following two books:
20   - Andrew J. VITERBI: "CDMA - Principles of Spread Spectrum Communication" Addison-Wesley Wireless Communications Series, 1975,
            - John G. PROAKIS: "Digital Communications" McGraw-Hill International Editions, 3rd edition,
25   1995.

One particular embodiment of this technique called orthogonal keying of order M, or "M-ary Orthogonal Keying" (MOK), one signal among a set of orthogonal signals is associated with each digital symbol to be
30   transmitted. These signals may be spreading sequences in the same family of orthogonal sequences; in this

B 13498.3 RS

case, the modulation also does the spreading. But these signals may also be not perfectly orthogonal.

If a symbol is composed of m bits, there are 2^m possible configurations for the different symbols. Therefore the number M of available sequences must be equal to at least 2^m. If the length of these sequences is N, it is known that not more than N orthogonal sequences can be found. Therefore, we have M = N and the number of bits per symbol is limited to $log_2 N$.

There is a variant to the MOK technique called "M-ary Bi-orthogonal Keying" (MBOK) that consists of adding opposite values to the set of orthogonal signals used in a MOK modulation, to form a set of 2M signals, which are obviously no longer all orthogonal to each other. Demodulation uses other M correlators adapted to each of the M orthogonal sequences but also necessitates means of retrieving the sign.

In French patent application No. 99 08308, June 29 1999, the Applicant of this patent described and claimed a variant called multi-MOK or M-MOK for short. In this variant, the number of MOK modulation/demodulation operations is multiplied to deal with several data blocks. Naturally, this increases the number of sequences, but it also (very significantly) increases the information throughput.

Finally, in his application No. 99 09947, July 30 1999, this Applicant described and claimed a process using repetitive sets of spreading sequences. In this technique, designed to reduce risks of interference between symbols, successive symbols are processed with different pseudo-random sequences, so that the received

B 13498.3 RS

signals can be better discriminated on reception. The number of different successive sequences is limited to a fixed number S. After S sequences, previously used sequences are reused. In other words, packets of S

5   symbols are processed by repetitive sets of S sequences. The result is that the time interval after which the same pseudo-random sequence is found again is S.Ts, if Ts is the duration of a symbol. In terms of throughput, this means that for given spreading, the

10   allowable throughput is S times higher than in prior art.

This process, that consists of processing packets of S symbols by repetitive sets of S pseudo-random sequences, can be improved by processing L packets of S

15   symbols in parallel, with L sets of S different sequences giving a total of LS sequences.

In the last mentioned patent application, sets of sequences are obtained by reading a table (reference 50 in the application) containing LS pseudo-random

20   sequences denoted Cij, and this is done by addressing this table with L addresses in parallel and the L required set of sequences are retrieved on L outputs in parallel. The remaining step is to spread the symbols Sij using the corresponding sequences Cij.

25   The purpose of this invention is to improve this generator of sets of spreading sequences.

Presentation of the invention

According to the invention, the address formed is

30   no longer composed only of q bits of symbols to be processed (as is the case in the MOK technique in which

B 13498.3 RS

4

the q bits address one of the 2^q sequences), but it also includes additional bits corresponding to the S sequences. Log_2S additional bits are necessary to address S different sequences, and therefore the address must include a total of $q+log_2S$ bits.

More precisely, the purpose of this invention is a generator of repetitive sets of spreading sequences for the transmission of symbols by spread spectrum, characterized in that it comprises:

a) means of counting and forming an address comprising:

- an input, receiving the symbols to be processed;

- a synchronization input, receiving pulses synchronized with the symbols;

- means of counting the number of received symbols and forming an address, this address comprising a first part composed of a number q of bits where q is the number of bits in each symbol, and a second part composed of a number r of bits where $r = log_2S$, and where S denotes the number of sequences in a set of sequences, the address thus comprising a number p of bits where $p = q+log_2S$;

- an output on which this address can be collected, for each input of a symbol applied to the means.

b) a sequences table comprising a number L of blocks (where $L=2^q$), each block memorizing a set of S sequences, this table being addressed by the address output by the counting and

addressing means, the first part of the address selecting one set among L and the second part selecting a sequence in this set.

5 ## Brief description of the drawings

The single figure is a diagrammatic view of the generator according to the invention.

Description of a particular embodiment

10 Figure 1 shows a generator 10 according to the invention, with a main input 12 into which the numeric symbols S_{ij} are input, and an output 14 through which the spreading sequences C_{ij} are output. This generator 10 comprises essentially means 20 of counting and

15 forming an address and a table 30 containing L sets of S sequences.

The means 20 comprise an input 22 receiving the symbols S_{ij} to be processed, and a synchronization input 24 receiving the pulses Hs synchronized with the

20 symbols.

The address formed by means 20 comprises a first part A composed of q bits, where q is the number of bits in each symbol, and a second part B composed of a number r of bits where $r = \log_2 S$, and S denotes the

25 number of sequences in a set of codes. Thus the address AB comprises a number p of bits where $p = q + \log_2 S$. Therefore, this address has been extended and is longer than it was in prior techniques in which it only contained q bits.

30 The means 20 also comprise an output 26 containing the address to the table 30 that follows.

This table 30 comprises a number L of blocks Ai in which index i varies from 1 to 2^q, each block memorizing a set of S sequences Bj where j varies from 1 to S. Therefore, the first part A of the address will select one block Ai among L, and the second part B will select one sequence Bj in this set. Finally, the address (AB) selects one sequence Cij among LS. These sequences are output through output 14.

For example, it would be possible to work starting from a single QPSK modulation (2 bits per symbol) on symbols with 4 bits per symbol (q=4) corresponding to 4 blocks Ai of 2 MOK bits, and using sets of S=4 sequences giving a total of 16 sequences which gives r = $log_2 S$ = 3. The number of bits in the addresses will then be equal to 2 + 2 = 4.

In one modulation using the generator according to the invention, a set of repetitive codes is used and the sequencing of these codes is known on reception. Therefore, provided that synchronization is good, it is a priori possible to know the next code in each of the sets. Thus, the number of adapted filters necessary for the code skip part is no longer S, and is equal to 1 in the case of spread spectrum keying by direct sequence with single code skip, and 2^q in the case of a modulation with MOK type code skip, or N.2^q in the case of a multi-code modulation with single code skip and MOK. Furthermore, it would be possible to use sliding correlators rather than adapted filters in order to simplify the embodiment. These sliding correlators can be controlled by an adapted filter that controls

B 13498.3 RS

synchronization as described in document FR-A-2 779 590.

S.2^q adapted filters are necessary to demodulate the data in reception in the case of the example of modulation with single code skip and MOK, without any reduction in complexity, while with the reduction in complexity resulting from this invention, 2q sliding correlators and one adapted filter are sufficient.